



United States
Department of
Agriculture

Forest
Service

October 2019



Fire and Fuels Report

Northshore Restoration

Upper Lake Ranger District, Mendocino National Forest
Lake County, CA



Prepared By: [Hinda Darner](#)
Fuels Officer

NON-DISCRIMINATION POLICY

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the bases of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, or all or part of an individual's income is derived from any public assistance program, or protected genetic information in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases will apply to all programs and/or employment activities.)

TO FILE AN EMPLOYMENT COMPLAINT

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (PDF) within 45 days of the date of the alleged discriminatory act, event, or in the case of a personnel action. Additional information can be found online at www.ascr.usda.gov/complaint_filing_file.html.

TO FILE A PROGRAM COMPLAINT

If you wish to file a Civil Rights program complaint of discrimination, complete the [USDA Program Discrimination Complaint Form](#) (PDF), found online at www.ascr.usda.gov/complaint_filing_cust.html, or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter to us by mail at U.S. Department of Agriculture, Director, Office of Adjudication, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, by fax (202) 690-7442 or email at program.intake@usda.gov.

PERSONS WITH DISABILITIES

Individuals who are deaf, hard of hearing or have speech disabilities and you wish to file either an EEO or program complaint please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

Persons with disabilities who wish to file a program complaint, please see information above on how to contact us by mail directly or by email. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.) please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

TABLE OF CONTENTS

Non-Discrimination Policy	1
To File an Employment Complaint	1
To File a Program Complaint	1
Persons with Disabilities	1
NON-DISCRIMINATION POLICY	1
TO FILE AN EMPLOYMENT COMPLAINT	1
TO FILE A PROGRAM COMPLAINT	1
PERSONS WITH DISABILITIES	1
TABLE OF CONTENTS	1
1.1 INTRODUCTION	2
1.2 PURPOSE AND NEED	2
1.3 DESIRED CONDITION	3
1.4 METHODOLOGY	5

1.5	AFFECTED ENVIRONMENT	17
	Area Description.....	17
	Fire	17
	Fire History.....	17
	Fire Ecology	21
	Weather	21
1.6	EXISTING CONDITION	22
	Stand Conditions	22
	Fuel Model and Loading.....	17
	Fire Regime and Condition Class	26
	MFRI- Mean Fire Return Interval.....	26
	Indicator #1 Fire Activity Type	27
	Indicator #2 Flame Lengths-Fireline Intensity.....	28
1.7	ENVIRONMENTAL CONSEQUENCES.....	29
1.7.1	alternative 1: No Action Alternative	29
1.7.2	alternative 2: Proposed Action	31
1.7.3	alternative 3:	35
1.7.4	alternative 4:	36
1.7.5	alternative 5:	Error! Bookmark not defined.
1.8	SUMMARY OF EFFECTS.....	36
1.9	COMPLIANCE WITH LAW, POLICY, REGULATION, AND FOREST PLAN	37
	MENDOCINO NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN DIRECTION	37

1.1 INTRODUCTION

This report analyzes and summarizes the condition of wildland fuels and potential fire effects of the Northshore Restoration Project.

Refer to the Northshore EA for further information on the Proposed Action and Alternatives.

1.2 PURPOSE AND NEED

From our analyses, we have concluded that a need exists to reduce current and future hazardous fuels in order to maintain and restore wildfire resiliency to the project area. The 2018 Ranch Fire burned much of the project area at extremely high severity causing significant mortality to the stands. These stands will contribute to future excessive fuel loading. Without active post-fire management, rapid post-wildfire fuel succession (dead woody fuel dynamics) and regeneration of nontree vegetation (shrub and herbaceous) will predispose the recovering early-seral forests to future repeat high-severity reburns (Coppoletta *et al.* 2016). In order to protect remaining green trees and stands, protect wildlife habitat, protect communities and watersheds, and successfully restore fire into the ecosystem there is a need to reduce these fuel accumulations and restore the area to a more fire resilient condition. The intensity of treatment and level of active management will depend on the need. Where conditions allow, nature will be allowed to take its course with as little management as possible. For example, within the WUI area where fire suppression will likely continue to be very hands on, active management will be more necessary than a more remote area where fire may be able to play its natural course with little intervention. However, other circumstances (environmental, social, political) may intervene with this allowance of fire on the landscape, and in such cases, light or moderate management such as prescribed burning and associated preparation needed to safely and effectively conduct such an operation may be

necessary. Therefore, there is a need to have as many tools as possible to treat this project area in the best way possible.

1.3 DESIRED CONDITION

The desired condition of the project area is one that is more resilient to wildfires where fire can be appropriately managed in the wildland urban interface (WUI) areas as well as the areas surrounding.



Figure 1 – Example Desired Condition

Guidance from the Mendocino National Forest Land and Resource Management Plan (LRMP):

Land management activities on the Upper Lake Ranger District are directed by the Mendocino National Forest (MNF) Land and Resource Management Plan (LRMP), dated February 1995. This document specifies forest-wide standards and guidelines, as well as area-specific guidelines. Regarding fuels treatments and fire hazards, it directs (Section IV- Management Direction: Fire and Fuels, pg 20-21):

Maintain a cost effective detection, prevention, suppression, and fuels management program in support of other resource programs. (MNF LRMP IV-2)

In order to accomplish that goal, the LRMP emphasizes “fuel treatment efforts for fire hazard reduction purposes in the following areas:

Natural fuels:

- Continuous, mature brush stands of more than 150 acres adjacent to or within areas of urban interface, resource investments, or high fire hazards;
- Continuous, mature brush stands more than 25 years old;
- Continuous, mature brush stands with dead-to-live ratios greater than 35%.
- Forested areas with excessive accumulations of natural fuels.

Activity fuels:

- In zones of urban interface or other high fire hazard areas

Guidance from the Mendocino National Forest Late Successional Reserve Assessment (LSRA):

The Mendocino National Forest LSRA provides the following guidance:

- The objective for management of late successional reserves is to protect and enhance late successional forests to provide habitat for populations of species dependant on late successional and old growth forest ecosystems (ROD). LSRA p.9
- Mid-to-late successional pine, mixed conifer and hardwood stands are capable of enduring the effects of a mid-summer wildfire under normal severe conditions without setting the stand back to an earlier successional stage. (MNF LSRA p9)
- The LSRA (p41) describes undesirable wildfire effects as tree mortality >25%. Fuel management strategies and techniques that reduce the intensity of wildfires, limit flame lengths to less than four feet, and reduce the likelihood of crown fires would reduce tree mortality to less than 25% and maintain late successional habitat. LSRA p35
- Fuelbreaks should be constructed to provide safe access for fire suppression actions, prevent crown fires on major ridges to reduce potential for long spotting distances, and to facilitate future prescribed burning operations.
- Underburning designed to change a fuel model 10 to a fuel model 8 would reduce flame lengths.
- Moving MFRI towards a more historical level would increase the LSR’s resiliency to wildfire events.

1.4 METHODOLOGY

FFE-FVS was used to model to post fire fuel succession and potential reburn severity where data was collected. FFE-FVS is a semi-empirical, distance-independent individual tree growth-and-yield models with region-specific allometric growth equations which simulates forest succession (tree growth and mortality), snag decay and fall-down and dead woody fuel loading accumulation, decomposition, and fire behavior (Reinhardt and Crookston 2003). Model limitations: FVS does not model shrub growth or regeneration which occurs in post fire environments and contributes greatly to fire behavior. FVS also does not take into consideration surface fuels <3" DBH. These fuels also contribute to fire behavior and spread. FVS data in this report shows that over time, surface fuel loads increase greatly as dead trees fall to the forest floor. See Effects Analysis for the different alternatives.

Because the project area is large, collecting stand exams and browns transects across every acre is not feasible, therefore field analysis including the use of photos series was used to determine fuel accumulations across the project area. Photo series are useful tools for quickly and inexpensively evaluating vegetation and fuel conditions in the field. The Natural Fuels Photo Series is a collection of georeferenced data and photographs that collectively display a range of natural conditions and fuel loadings in a wide variety of forest-, shrub-, and grass-dominated ecosystem types. With assistance from the Joint Fire Science Program (JFSP) and others, the Fire and Environmental Research Applications (FERA) team, located at the Pacific Wildland Fire Sciences Laboratory, in Seattle, Washington, developed the Natural Fuels Photo Series to address this critical need for high quality fuels information.

FUEL LOADING

There are seven principal characteristics of fuel components that give an indication of potential fire behavior within a fuels complex. Fuel loading, size and shape, compactness, horizontal continuity, vertical arrangement, moisture content, and chemical content. Crown base height, canopy cover, crown height and crown bulk density all contribute to overall fire behavior.

The existing fuels condition is a result of combination of factors. These factors include historic vegetation conditions, fire history, fire suppression, management activities, forest health, weather events and climate influence. Prior to the Ranch Fire, the existing condition was primarily high density forested areas and chaparral lands both with heavy fuel loading (except areas where fuels reduction projects were being implemented). The Ranch Fire burned through the area at a very high intensity and extreme rates of spread. The remaining

landscape was left devoid of much living vegetation and an abundance (high density) of dead trees. This results in a very large area where the dead trees have already started to fall and will continue to fall for decades. In many areas, the dead trees that fall will create high surface fuel loads. This combined with revegetating species coming up under and amongst these logs (grasses, chaparral, tree regeneration where there are some trees left as seed sources) will very quickly become a source of highly combustible fuels in the next wildfire. As a result, the potential for the project area to burn at high severity again will increase dramatically. Wildfires under these conditions are larger, more intense, erratic, and difficult to control as exemplified in the Ranch Fire where in one burning period the fire spread across 53,479 acres covering much of this project area. The remnant trees are not only our largest trees left on the landscape but also our seed sources for natural revegetation.

Current surface fuel load accumulations are relatively low. Low amounts of surface fuel generally occur in the project due to the recent high intensity fire of 2018. As post-fire snags begin to fall, surface fuel loads will increase dramatically particularly in previously forested stands. Surface fuel loads are the receptive fuel bed and primary carrier of surface fire. The fuel loading is also directly related to the surface fire spread and flame lengths. In addition to the trees falling over time, shrub regeneration in the newly opened canopies will create a fuel bed conducive to reburn in future wildfires. Such a reburn is likely to produce very high intensity fires. This fire behavior will in most areas prevent trees (whether naturally regenerating or planted) from surviving future wildfires. This is a WUI area with a high occurrence of human caused ignitions. The probability of another wildfire occurring before this area can reach a succession stage that is more resilient to wildfires is likely.

The following figures 2 through 6 show examples of surface fuel loading amounts, differences in spatial distribution of fuels, and surface area to volume ratio differences (fine fuels vs. larger fuels). The composition of different size classes will affect fire behavior. For example, 20 tons per acre of fuels composed primarily of 3-9" logs vs 20 tons per acre of fuels composed primarily of 21"+ logs will influence fire behavior differently. Figures 9 and 10 also exemplify this important concept to be understood when discussing desired fuel loading levels.

Figure 2 – 100 acre LSR in Northshore

100 acre LSR Unit Before and After



Post Forks Fire, Pre Ranch Fire
(Photo taken 2010)



Post Ranch Fire
(Photo taken 2019)

Fuel Loading for photo above on left – pre Ranch Fire Browns transects

Brown's Transect Compilation - Downed Woody Weight and Volume per acre by size class:

Downed woody data will be properly compiled in this section only if the sample design adheres to Brown's original protocol, including the 0-0.24, 0.25-0.99, 1-2.99, and 3+ class sizes.

	0 - 0.24 in. class	0.25 - 0.99 in. class	1 - 2.99 in class	Sound 3+ in. class	Rotten 3+ in. class	Total of all classes
Tons/ac	.99	3.73	5.75	18.36	4.33	33.2
StdDev	.31	1.19	4.54	22.76	9.94	27.9
Cubic Ft/ac	66.37	248.74	460.55	1,471.08	462.48	2,709.2
StdDev	20.39	79.50	363.60	1,823.61	1,062.27	2,371.1

FFE-FVS Initial dead fuel loads for fields 1 through 5, in tons/ac:

	FUELINIT 1 (<1 in)	FUELINIT 2 (1 - 2.9 in)	FUELINIT 3 (3 - 5.9 in)	FUELINIT 4 (6 - 11.9 in)	FUELINIT 5 (12 in +)
Tons/ac	4.719199	5.747948	4.439829	7.399714	10.84922
StdDev	1.280859	4.537854	4.1110423	8.820928	21.50916

Figure 3 – Photo Series 5-MP-4 Photos series example of surface fuel tonnage by size class

5-MP-4



Data Sheet 5-MP-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.0	64
0.26- 1.0	2.1	137
1.1 - 3.0	4.8	385
3.1 - 9.0	5.6	545
9.1 -20.0	19.2	2019
20.1 +	13.9	1487
Total	46.6	4637

Comments:

Stand Information

Average diameter	(inches)	34
Average tree height	(ft)	138
Average crown length		77
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1985
Bole weight per tree		7567
Bark weight per tree		2020
Total weight per tree		11572
Bole volume per tree	(ft ³)	314

Residue Measurements

Average residue depth	(ft)	0.33
Ground area covered by residue	(pct.)	99
Average duff and litter depth	(inches)	2.4
Ground area covered by duff and litter	(pct.)	50
Sound residue 3.1 inches and larger		7
Rotten residue 3.1 inches and larger		93

Figure 4 – Photo Series 4-WF-2 Photos series example of surface fuel tonnage by size class

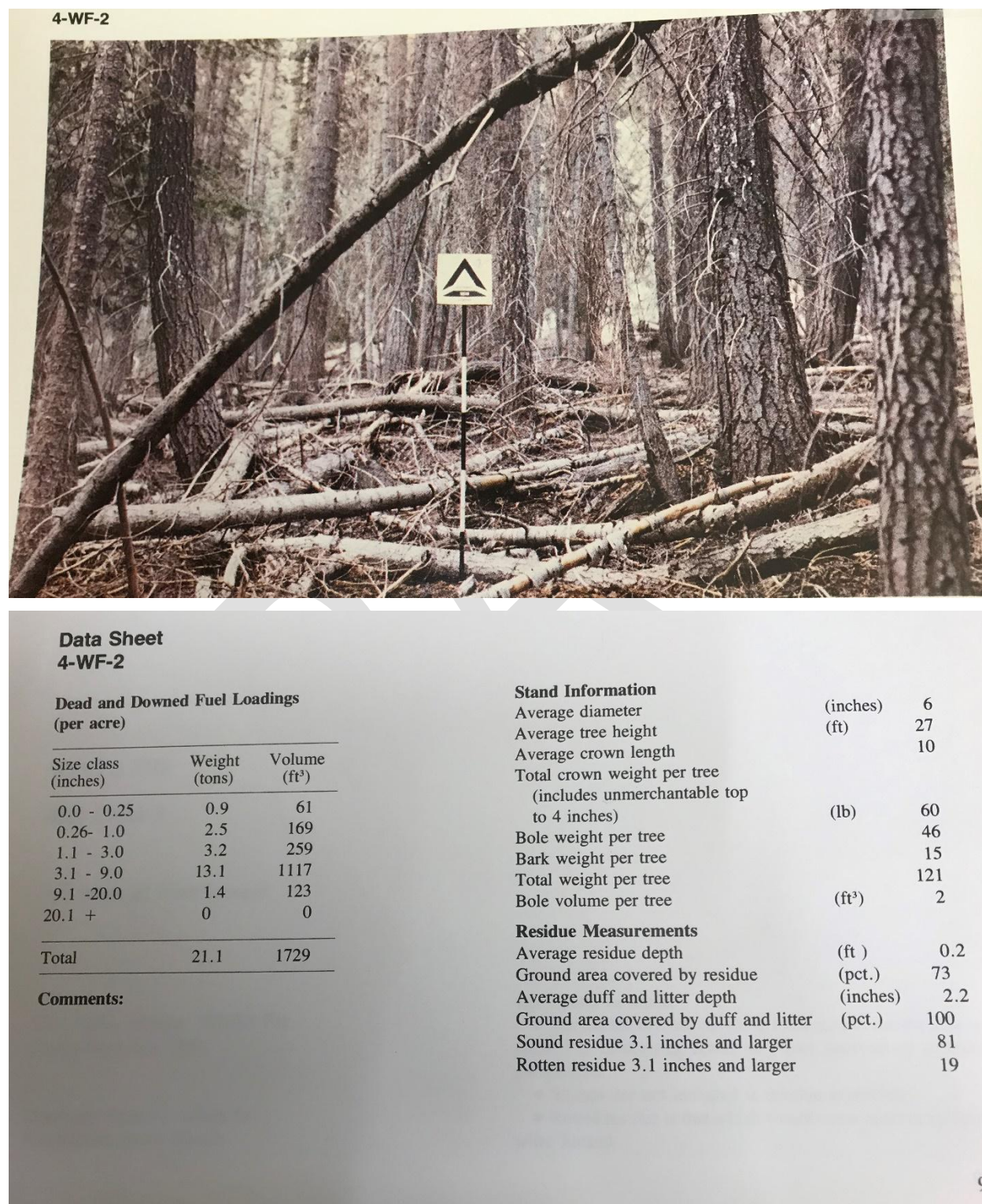


Figure 4 – Photo Series 4-MF-4 Photos series example of surface fuel tonnage by size class



Data Sheet 4-MF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	47
0.26- 1.0	2.1	140
1.1 - 3.0	3.3	264
3.1 - 9.0	2.3	214
9.1 -20.0	14.4	1493
20.1 +	16.4	1752
Total	39.2	3910

Comments:

Stand Information

Average diameter	(inches)	38
Average tree height	(ft)	139
Average crown length		78
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1770
Bole weight per tree		8501
Bark weight per tree		2754
Total weight per tree		13025
Bole volume per tree	(ft ³)	368

Residue Measurements

Average residue depth	(ft)	0.4
Ground area covered by residue	(pct.)	100
Average duff and litter depth	(inches)	3.4
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		8
Rotten residue 3.1 inches and larger		92

Figure 5 – Photo Series MC-13 Photos series example of surface fuel tonnage by size class



WOODY MATERIAL ✚ Add to custom site							FOREST FLOOR ✚ Add to custom site		
Diameter (in)	Loading (tons/ac)			Density (pieces/ac)				Depth (in)	Loading (tons/ac)
	Sound	Rotten	Total	Sound	Rotten	Total			
<= 0.25	0.40	0.00	0.40	--	--	--	Woody material	2.4	60.60
0.26 - 1.0	1.90	0.00	1.90	--	--	--	Surface material	0.4	1.30
1.1 - 3.0	3.20	0.00	3.20	--	--	--	Duff	1.8	21.30
3.1 - 9.0	23.00	5.70	28.70	681	321	1,002			
9.1 - 20.0	21.30	3.20	24.50	190	20	210			
> 20.0	0.00	1.80	1.80	0	5	5			
Total	49.80	10.70	60.50	871	346	1,217			

Figure 6 – Photo Series MC-17 Photos series example of surface fuel tonnage by size class



WOODY MATERIAL ✚ Add to custom site							FOREST FLOOR ✚ Add to custom site		
Diameter (in)	Loading (tons/ac)			Density (pieces/ac)				Depth (in)	Loading (tons/ac)
	Sound	Rotten	Total	Sound	Rotten	Total			
<= 0.25	0.40	0.00	0.40	--	--	--	Woody material	1.2	86.10
0.26 - 1.0	2.00	0.00	2.00	--	--	--	Surface material	0.4	1.10
1.1 - 3.0	2.60	0.00	2.60	--	--	--	Duff	1.2	14.70
3.1 - 9.0	19.90	1.80	21.70	633	107	740			
9.1 - 20.0	49.60	5.10	54.70	409	49	458			
> 20.0	4.70	0.00	4.70	10	0	10			
Total	79.20	6.90	86.10	1,052	156	1,208			

Figures 7 and 8 show examples of post wildfire surface fuel loading accumulations on the forest. These examples represent the undesired levels of fuel loads that have been documented in past fires on the Forest. The Ranch Fire post burn environment will also exhibit increases in fuel load into the future. The Back Fire was also re-burned during the Ranch Fire. The District has not revisited the specific sites that are in these figures but many areas with heavy down as a result of the Back Fire experienced very high intensity fires during the Ranch Fire.

Figure 7a – Back Fire Plots (8 years post wildfire, small diameter, these stands were lacking large diameter trees)



Plot ID: EMFB 1

Site Location: N 39° 21.578' X W 122° 59.370'

Elevation: 3603'

Aspect: W

Slope: 18%

Transect Azimuth: 343°

Fire History: Back Fire 2008

Vegetation Type: PSME PIPO PILA

Diameter (in)	# of intercepts	Loading (tons/ac)
≤ 0.25	128	2.66
0.26 – 1.0	9	3.24
1.1 – 3.0	10	13.36
3.1 – 6.0	9	14.97
6.1 – 9.0	3	19.12
9.1 – 20	0	0
20.1 >	0	0
Total	159	53.35

	Depth (in)	Depth (in)	Depth (in)	Average
Fuel Bed	23.0	12.0	21.0	18.67
Duff	1.0	1.0	1.0	1.0
Total	24.0	13.0	22.0	19.67

Figure 7a – Back Fire Plots (8 years post wildfire, small diameter, these stands were lacking large diameter trees)



Plot ID: EMFB 2

Site Location: N 39° 21.580' X W 122° 59.368'

Elevation: 3598'

Aspect: W

Slope: 20%

Transect Azimuth: 351°

Fire History: Back Fire 2008

Vegetation Type: PSME PIPO PILA

Diameter (in)	# of intercepts	Loading (tons/ac)
≤ 0.25	163	3.16
0.26 – 1.0	16	5.85
1.1 – 3.0	12	16.07
3.1 – 6.0	9	17.45
6.1 – 9.0	6	28.89
9.1 – 20	0	0
20.1 >	0	0
<u>Total</u>	206	71.42

	Depth (in)	Depth (in)	Depth (in)	Average
Fuel Bed	42.0	34.0	50.0	42
Duff	1.0	1.0	1.0	1.0
Total	43.0	35.0	51.0	43.0

Figure 8- Mill Fire (7 years post fire photos)



Figure 9 – Photo Series Tons/Acre Chart

Log Weights (Tons)		Length of log (feet)																
Diameter of log (inches)		8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
		4	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
		6	.02	.02	.03	.03	.04	.04	.05	.05	.06	.06	.07	.07	.08	.08	.08	.09
		8	.04	.04	.05	.06	.07	.08	.09	.1	.1	.1	.1	.1	.1	.2	.2	.2
		10	.06	.07	.08	.1	.1	.1	.1	.2	.2	.2	.2	.2	.2	.2	.3	.3
		12	.08	.1	.1	.1	.2	.2	.2	.2	.3	.3	.3	.3	.3	.4	.4	.4
		14	.1	.1	.2	.2	.2	.3	.3	.3	.4	.4	.4	.4	.5	.5	.5	.5
		16	.1	.2	.2	.2	.3	.3	.3	.4	.4	.5	.5	.5	.6	.6	.6	.7
		18	.2	.2	.3	.3	.4	.4	.4	.5	.5	.6	.6	.6	.7	.8	.8	.9
		20	.2	.3	.3	.4	.4	.5	.5	.6	.7	.7	.8	.8	.9	.9	1.0	1.0
		22	.3	.3	.4	.5	.5	.6	.7	.7	.8	.9	1.0	1.0	1.2	1.3	1.4	1.5
		24	.3	.4	.5	.6	.6	.7	.8	1.0	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8
		26	.4	.5	.6	.6	.7	.8	1.0	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0
		28	.4	.5	.6	.7	.9	1.0	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.0
		30	.5	.6	.7	.9	1.0	1.0	1.2	1.3	1.5	1.6	1.7	1.8	2.0	2.0	2.2	2.3
		32	.6	.7	.8	1.0	1.0	1.3	1.4	1.5	1.7	1.8	2.0	2.0	2.2	2.4	2.5	2.7
		34	.6	.8	.9	1.0	1.3	1.4	1.6	1.7	2.0	2.0	2.2	2.4	2.5	2.7	2.8	3.0
		36	.7	.9	1.0	1.3	1.4	1.6	1.8	2.0	2.0	2.3	2.5	2.7	2.8	3.0	3.2	3.4
		38	.8	1.0	1.0	1.4	1.5	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.7
		40	.9	1.0	1.3	1.5	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.3	3.5	3.7	4.0	4.4

5

Desired fuel loading

Surface fuel loading shall be left at levels that meet wildlife requirements for CWD while not exceeding manageable levels for prescribed fire management within a WUI (Brown et al 2003). Larger diameter logs are preferred over small diameter logs when meeting the 5-20 tons per acre (tpa) of CWD. Maximizing retention of larger diameter logs is critical in keeping surface fuel loadings within an acceptable range in terms of fire behavior that would allow for fuels management within a WUI.

Example of fuel loading ranges (See figure 10 for illustration):

1. One 20 inch diameter log that is 20 feet long represents 0.5 tons per acre (figure 1). 20 tons tpa would consist of 40 logs per acre in the 20" dbh size class. Having 40 logs per acre of this size class is not manageable for prescribed burning until this stand has matured and reached a more fire resilient successional stage. This level of fuel loading creates flame lengths and heat intense enough to cause mortality to any vegetation regrowth.
2. One 40 inch diameter log that is 20 feet in length would be 2.2 tons per acre. 20 tpa would consist of 9 logs per acre in the 40" dbh size class. While this is still high, the

larger size is more manageable from a fuels treatment and fire resilience perspective as opposed to the example above (40 logs, 20 inches in diameter).

3. The objective of the CWD retention is to balance the firefighting objectives within the WUI while maintaining the habitat diversity and complexity that comes from maintaining the important component of the down wood. This balance lies somewhere in between the fuel loading ranges given in the examples above.

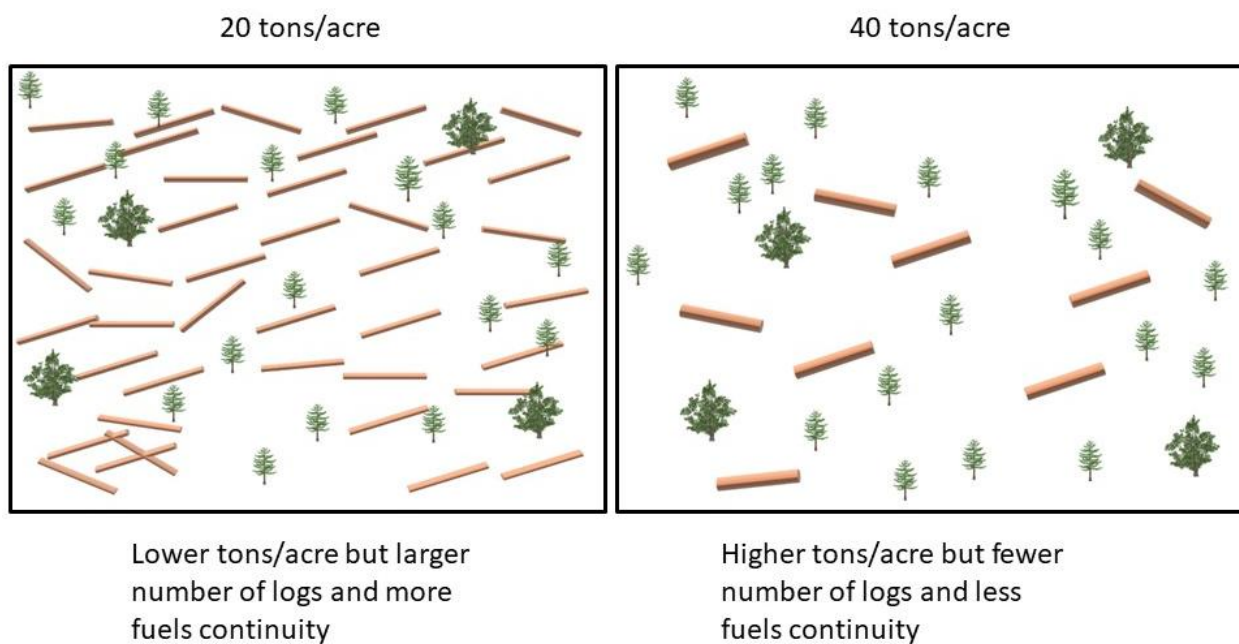
4.

CWD is defined as 15" dbh logs and greater. See wildlife report.

Where no 20" or greater log exists, logs down to 10" dbh may be left on the ground at no more than:

1. 10" log 10/acre
2. 12-14" log 8/acre
3. 14-20" log 6/acre

Figure 10 - Example Fuel Tonnage Not Created Equal*



* Not to scale.

FUEL MODEL

Standard Fire Behavior Fuel Models by Scott and Burgan: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model : SB202 and 203 were used to model fire behavior of surface fuels composed of dead trees and limbs that have fallen to the ground. This higher load of fine fuels represented in these fuel models are mimicked by the shrubs that will be present growing amongst the heavy dead and down fuel load. Note that SB202 and 203 are a conservative look at fire behavior potential in much of the project area. SH4 can be used to describe fire behavior of chamise type shrubs (years 0-5) that come in post fire. Around years 5-10 SH6 becomes more representative of fire behavior characteristics. 10 years post fire, we start to see some dead component interacting with the live component (whether naturally decaying or left over skeletons from the fire) and this age class is better characterized by fire behavior of SH7.

1.5 AFFECTED ENVIRONMENT

AREA DESCRIPTION

The North Shore Restoration project area is within the 2018 Ranch Fire on the Mendocino National Forest. The entire project area is within the Berryessa-Snow Mountain National Monument (referred to as Monument in the rest of this document). The project area lies upslope mainly to the East/North East of the foothill communities of Lucerne, Glen Haven and Clearlake Oaks on the North/Northeastern shoreline of Clear Lake. In 2012, the Forest signed an Environmental Analysis and began implementing a hazardous fuels reduction project that was designed to protect the Forest Lands (and the private land inholdings) from the many wildland fire ignitions that occur in the grassy foothills of the above listed communities and to protect these same communities from fires coming into them from National Forest Lands. Both the Forks Fire in 1996 and the Ranch Fire in 2018 involved the latter scenario. This project had been partially implemented when the Ranch Fire of 2018 burned through the entire project area.

FIRE

Fire Threat/Hazard

The project lies adjacent and upslope of the communities of Nice, Lucerne, Glenn Haven, Clear Lake Oaks and Upper Lake. The project area also contains numerous parcels of private property. There is a significant threat of wildfire entering the National Forest from these foothill communities where human caused fire starts are regular during the fire season. Fire history also shows that fire has threatened these communities from several past large wildfires that traveled from the North/ North East through the Forest and towards these communities. Potential ignition risk sources include human causes as well as lightning causes although the latter is less common in within this project area as compared to some areas on the Forest to the North.

FIRE HISTORY

Table 1 shows the forest fire history records for the project area. Figure 1 is a map of the fire history for the Northshore project area. Local experience shows that fires that exceed 10 acres usually escape initial attack. Many fire ignitions occur in the communities on a yearly basis. And the communities have also been threatened by fires burning from the Forest.

Figure 11 – Fire History Ignition Points

Fire History and Ignition Points

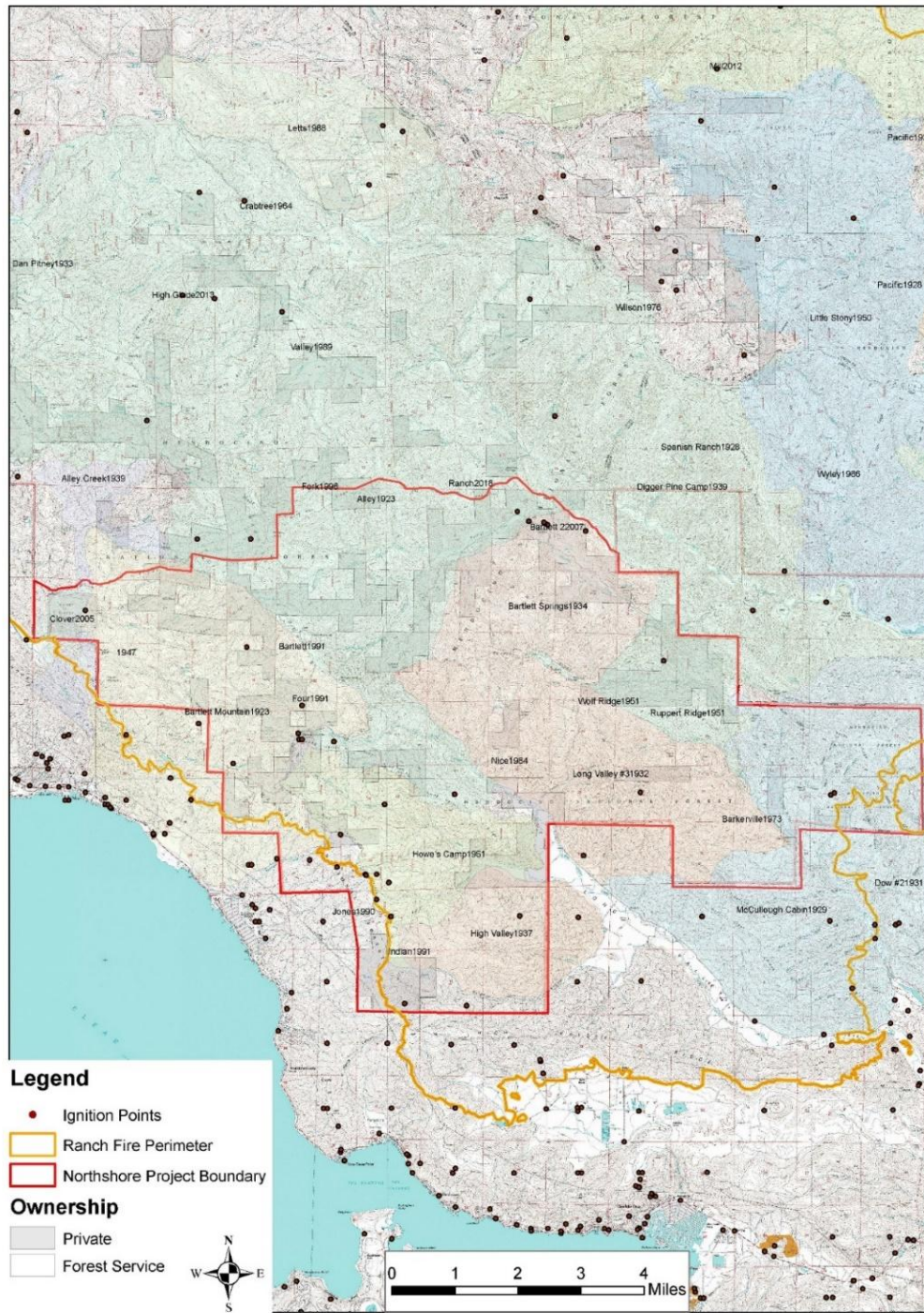


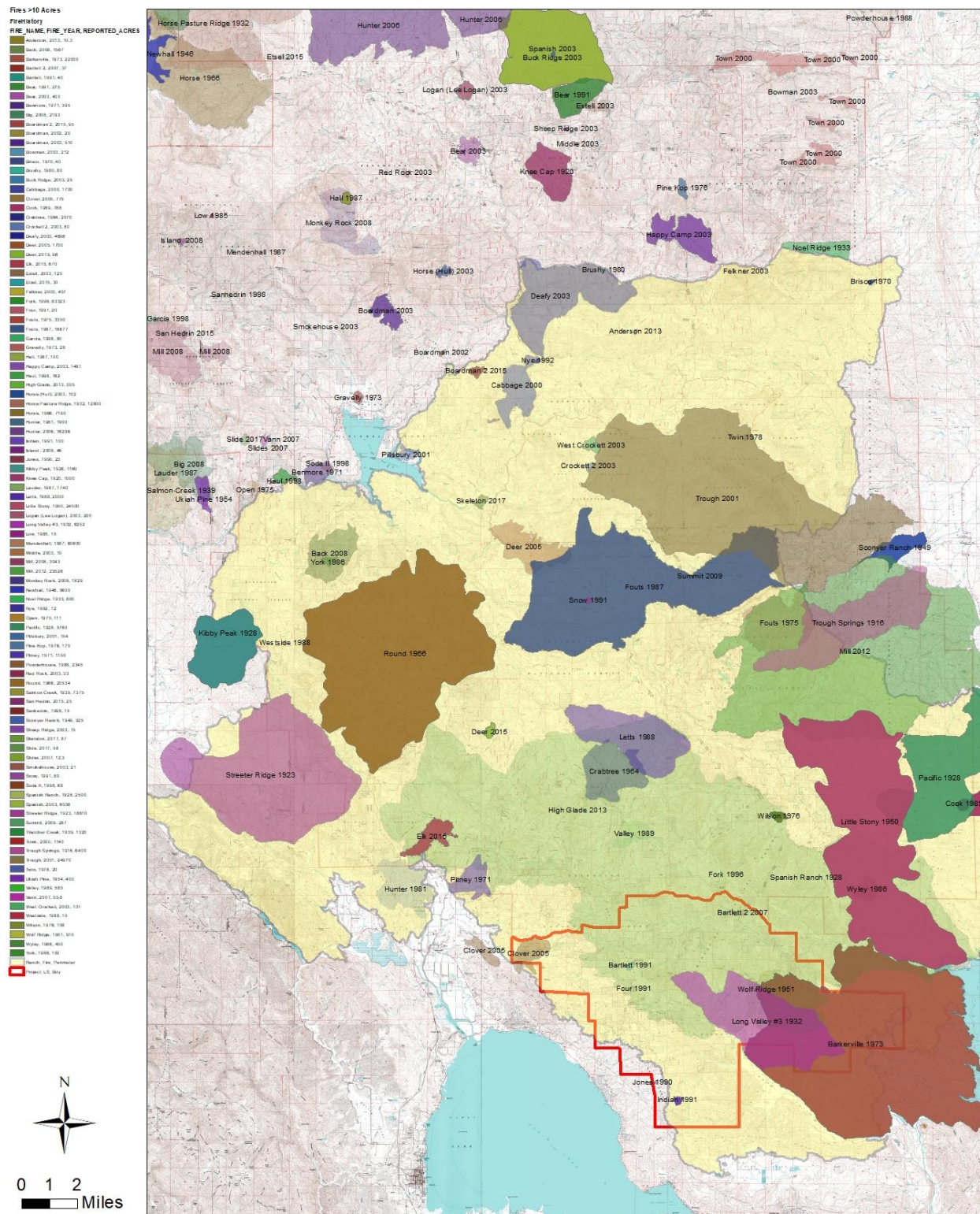
Table 1 – Large Fire History Within Northshore Project Area**

FIRE NAME	YEAR	CAUSE DESCRIPTION	AGENCY	ACRES BURNED WITHIN PROJECT AREA	TOTAL ACRES FIRE SIZE
Alley	1923	arson	USF	937	1595
Bartlett Mountain	1923	arson	USF	6523	9952
McCullough Cabin	1929	arson	USF	157	1514
Dow #2	1931	arson	USF	4	1229
Long Valley #3	1932		USF	6042	6905
Bartlett Springs	1934	miscellaneous	USF	4288	4316
High Valley	1937	arson	USF	2165	2843
Digger Pine Camp	1939	miscellaneous	USF	68	4012
	1947		CDF	1691	3864
Wolf Ridge	1951	lightning	CDF	879	879
Ruppert Ridge	1951	lightning	CDF	418	418
Howe's Camp	1951	miscellaneous	USF	4864	4864
Barkerville	1973	miscellaneous	USF	8276	26407
Nice	1984	miscellaneous	CDF	478	478
Jones	1990	debris burning	USF	12	19
Indian	1991	debris burning	USF	49	49
Four	1991	debris burning	USF	18	18
Bartlett	1991	debris burning	USF	45	45
Fork	1996	arson	USF	20388	82992
Clover	2005	miscellaneous	CA	516	927
Bartlett 2	2007	miscellaneous	USF	36	36
Ranch	2018			37937	409880
Total Acres				95790	563242

** This table is only large fires and does not include the many ignition points that have occurred but were suppressed at a small size.

Figure 12 – Fire History Within and Around Northshore Project Area

Fire History - 10 Acres or Greater in Size



FIRE ECOLOGY

WEATHER

Climate of the area is considered Mediterranean, with generally hot, dry summers and cool, wet winters. Yearly precipitation averages from 33-45 inches per year, falling mainly from November through March. Higher elevations accumulate periodical snow for short periods of time over the winter months. The area often receives no precipitation between June to October, and temperatures during this time may exceed 100°F.

Fire season on the Mendocino National Forest typically begins in mid to late May as seasonal precipitation dramatically decreases.

The thunderstorm season in the area is typically June through September, with the majority of thunderstorms passing through during June. One of such storms ignited the Soda Complex in 2008, which burned 6,500 acres in a 6 week period during the early part of fire season (June). The Back Fire was a part of the Soda Complex. Lightning also started several fires in August of 2015 on the Upper Lake and Covelo Ranger Districts. Precipitation is usually light from these thunderstorms. The most active months of fire activity marked by high fire indices are July through late September. North winds often occur in September and October bringing gusty winds and low relative humidity to the area, further raising fire danger for short durations. Fire season usually ends by the first couple inches of rain in late October or early November.

For this analysis, weather from High Glade RAWS, Konocti RAWS, and the Incident Action Plans (IAP) of the Ranch Fire on the days it burned through the project area were used.

Table 2 – IAP Weather and RAWS data on days of active burning in the project area during the Ranch Fire

From IAP									
Date	Temp	RH	Wind sp	Wind Dir	FDFM	10hr FM	100 HRFM	1000 HRFM	Live Woody FM
8/2/2018	98	10	12 gust 20	NW	3		7	8	
8/3/2018	96	10	12 gust 20	NW	3		7	8	
8/4/2018	90	19	15 gust 28	NW	4		7	8	
8/5/2018	92	13	14 gust 22	NW	3		7	8	
8/6/2019	97	13	13 gust 20	NW	3		7	8	
High Glade RAWS									
Date	Temp	RH	Wind sp	Wind Dir	FDFM	10hr FM	100 HRFM	1000 HRFM	Live Woody FM
8/2/2018	83	7	9 gust 24			2.9			155 DF 66 Chamise
8/3/2018	80	11	9 gust 21			3.3			
8/4/2018	76	13	9.7 gust 27			3.3			
8/5/2018	76	16	8 gust 21			3.7			
8/6/2019	81	9	8.8 gust 23			3.3			
Konocti RAWS									
Date	Temp	RH	Wind sp	Wind Dir	FDFM	10hr FM	100 HRFM	1000 HRFM	Live Woody FM
8/2/2018	96	8	9.4 gust 23			2.8			
8/3/2018	93	11	7.9 gust 31			3.2			
8/4/2018	88	14	11.9 gust 29			3.2			
8/5/2018	88	13	8.9 gust 25			3.6			
8/6/2019	94	10	11 gust 28			3.2			

1.6 EXISTING CONDITION

STAND CONDITIONS

Burned Area

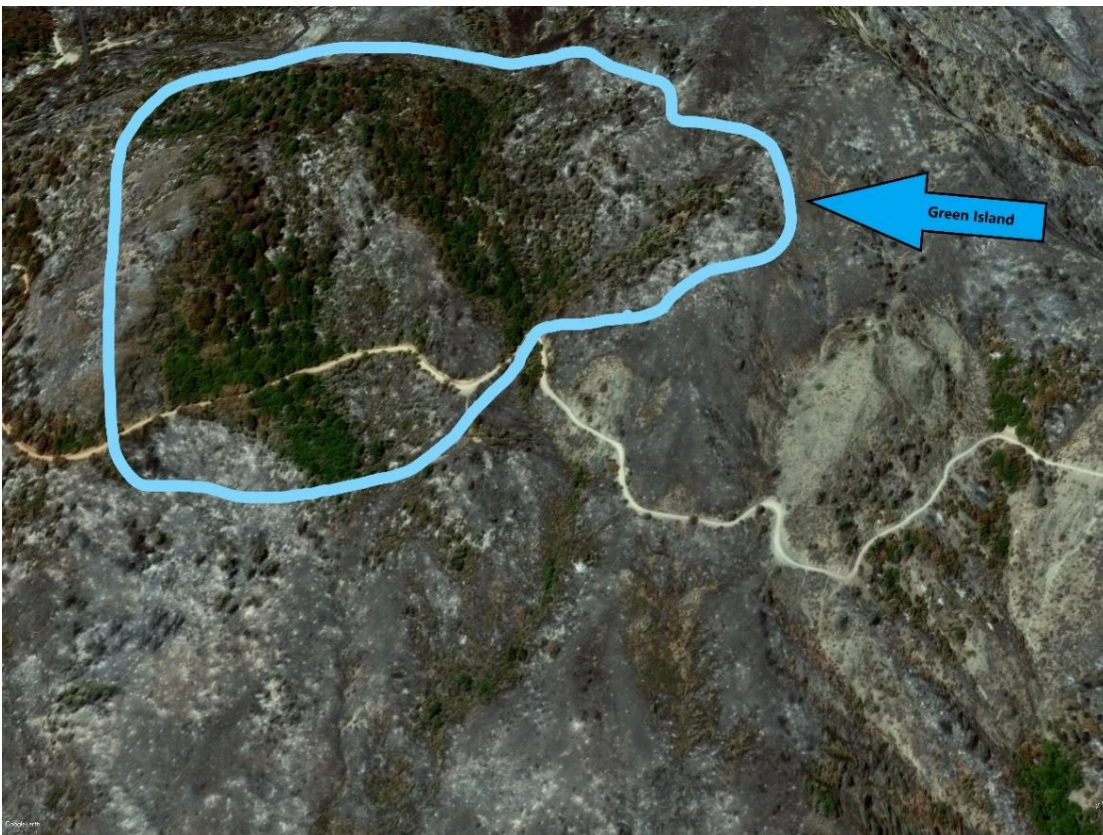
For this report, burned area is the area burned during the Ranch Fire. Stand conditions vary, but most of the burned area has very high mortality with much of the surface fuels consumed during the fire. High density stands left behind what is now high densities of snags in all size ranges (primarily Douglas fir, oak, ponderosa pine and knobcone pine) that are falling to the ground. Thickets of knobcone pine are regenerating quickly and growing up amongst chaparral and falling dead knobcone pine trees. See figure 13.

Figure 13- Burned Timber**Figure 14 – Knobcone**

Figure 15a – Green Islands within burned area



Figure 15b – Green Islands within burned area



Unburned Area

Unburned areas in the project lie primarily in the hills above the North Shore of Clear Lake. Utilizing roads, ridgetops and Forest Service Fuels treatments, the Ranch Fire was successfully contained before reaching the communities on North Shore. The remaining unburned areas include areas of primarily chaparral stands as well as transition zones of forested landscapes. Active suppression and lack of management has led to dense, decadent chaparral and forests that are not resilient to fire.

Figure 16 – Unburned Chaparral dominated areas



FIRE REGIME AND CONDITION CLASS

Fire regimes describe the historical ecological role of fire in creating and maintaining vegetation communities before Euro-American settlement activities and active fire suppression began. Fire regimes on the MNF have and continue to determine the Forest's vegetation and fuels conditions. The forest includes both fire-maintained ecosystems, in which frequent low intensity surface fires maintain vegetative conditions (i.e. ponderosa pine) as Fire Regime 1; and fire initiated ecosystems in which stand replacing events initiate new vegetation cycles (i.e. fir or chaparral) as Fire Regime 2.

Fire on more mesic sites occurred most often in the late summer or fall months (August-October) similar to recorded observations elsewhere in the region (Taylor and Skinner 1998, Taylor and Skinner 2003). On drier sites however, a significant portion (85%) of fires before 1850 occurred from spring to mid-summer (Skinner et al 2009). Fire intensity was generally low, killing pockets that burned at higher intensities due to variation in fuels and burning conditions across the landscape. However, there is evidence of naturally occurring higher severity fires even in these historical fire regimes, but at a less frequent interval. Fire regimes of this type have also been estimated to experience much more severe fires once every few centuries (200-1,000 years) when climate conditions line up (un)favourably Kilgore 1981, Barrett et al 2010). Ignition sources historically included lightning, and human-caused fires started by native peoples (Skinner et al 2009, Keter 1995, Brown 2000, Keeley 2002). During the last half of the 20th century, aggressive fire suppression and climate changes have resulted in increased forest density, fuel accumulation and interval between fires (Stuart and Salazar 2000; and (Calkin et al. 2005).

MFRI- MEAN FIRE RETURN INTERVAL

Two of the most recent large fires that burned the project area were the Ranch Fire of 2018 which burned 100% of the project area at very high intensity and the Forks Fire of 1996 which burned at varying intensities burning 52% of the project area. The Forks Fire changed many forested stands to shrub and knobcone dominated stands. Green trees that were in the vicinity of dead trees on the ground in combination with shrub and knobcone regeneration (or even in some cases – see 100 acre LSR scenario- where shrub regeneration wasn't an issue but density and dead fuels contributed to high fire intensity) experienced much higher fire intensity than would have occurred had the area had the MFRI of a more historic condition.

Several studies support the idea that the project area historically experienced, in general, a more frequent fire return interval with lower fire intensities. Landscapes that supported fire regimes with higher fire frequencies and lower fire intensities, such as those that occurred under historical regimes, were much more fire resilient. While higher severity patches

occurred, even in these types of fire regimes, these patches supported the need for habitat diversity while significantly reducing the risk of losing a majority of the forested landscape which provides critical habitat for certain species. Landscapes that existed under these fire regimes represent fuel types and conditions that would be more manageable from a fuels management and suppression standpoint in a WUI area. It's important to note that an MFRI or fire regime of historical values may not be achievable nor practical, but the landscape it represented is something to consider moving the area towards as a more fire resilient one. Because of soci-economic differences, climate change, a long history of fire suppression and changed conditions (such as conditions after the Ranch Fire) having fire on the landscape will take more management than it did historically and may require managers to consider new approaches (for example, encouraging the growth of oaks and hardwoods instead of planting conifers in sites where conifers will not thrive and oaks are naturally coming back.

There are several studies indicating a much shorter fire return interval than currently exists. A study done by Skinner, which included several plots on the Forest, indicate that mixed conifer forests like the ones in the project area developed with fires of generally low intensities occurring very frequently, with a median fire return interval of about 5.5-8 years for sites studied for all fire scars and 10-12 years for >2 scars per study site (Skinner and Others 2009). These studies found fire occurrence on the Mendocino to be higher than reported on other forests in the area such as the Klamath N.F. (Wills and Stuart 1994), the Six Rivers N.F. (Stuart and Salazar 2000) and the Lassen N.F. (Beaty and Taylor 2001).

A small study within the Middle Fork Eel watershed looked at stump scars which indicated that, on average, a fire intense enough to scar trees occurred every 30 years. The study by Rubiaco included trees from the Upper Main Eel Watershed. Slab analysis is limited to detecting fires that were intense enough to leave scars on trees. It is probable that many low intensity fires occurred that did not leave scars. The Upper Main Eel Watershed Assessment concludes that it is reasonable to state that the average interval between scarring fires prior to effective fire suppression would be between 10-25 years for most of the lower elevation forest ecosystems of the Upper Main Eel watershed. And additional small studies conducted in the Sugarfoot Fire area showed a fire return interval between 10 and 21 years for low elevation ponderosa pine dominated forest. (Watershed Analysis Report for the Upper Main Eel Watershed)

INDICATOR #1 SURFACE FUEL LOAD

Surface fuel loading shall be left at levels that meet minimum wildlife requirements for CWD while not exceeding manageable levels for prescribed fire management and fire suppression concerns within a WUI. Larger diameter logs are preferred over small diameter logs when meeting the 5-20 tons per acre of CWD recommended in "Course Woody Debris: Managing

Benefits and Fire Hazard in the Recovering Forest (Brown et al., 2003). However, because fuel loading dynamics as related to different size class distributions has an effect on fire behavior, retaining the lower end (5tpa) of this range in smaller diameter trees while maximizing retention of the larger diameter logs on the higher end (20tpa) is critical in keeping surface fuel loadings within a manageable range.

Example of fuel loading ranges in different size classes not being equal in terms of fire behavior and fuels reduction:

A 16" dbh log that is 20' long is 0.5tpa. 20tpa consisting of 16" dbh logs (the upper limit recommended) equates to 40 such logs on one acre. Retaining 40 logs of this size is not conducive to keeping prescribed burning on the landscape until this stand has matured into a much larger and fire resilient succession stage.

A 40" dbh log that is 26' in length would be 2.8 tpa. 20tpa consisting of 40" dbh trees equates to 7 such logs on one acre. While this is still high, it is more manageable from a fuels management and fire resilience perspective than 40 16" dbh logs.

CWD is defined as 15" dbh logs and greater. See wildlife report.

INDICATOR #2 FLAME LENGTHS

Fireline intensity is used to relate visible fire characteristics and interpret general suppression strategies. One visual indicator of fireline intensity is flame length (Rothermel 1983). In general, when flame lengths are less than 4 feet, direct attack at the head and flanks is possible and suppression strategies such as handlines and hose lays should stop spread of fire. When flame lengths are greater than 4 feet, fires are too intense for direct attack strategies. Table 9 compares fireline intensity, flame length, and potential suppression difficulty in more detail. Much of the project area would be represented by fuel models exhibiting greater than 4 feet flame lengths within the next 5-10 years.

Table 4 – Flame Lengths Interpretation (Table based on Rothermel 1983)

Fireline Intensity	Flame Length	Interpretations
Low	< 4 feet	Direct attack at the head and flanks with hand crews; handlines should stop spread of fire
Moderate	4-8 feet	Fires are too intense for direct attack on the head by persons using hand tools. Handline cannot be relied on to stop fire spread. Equipment such as dozers, engines, and retardant

		aircraft can be effective.
High	8-11 feet	Fires may present serious control problems-torching, crowning, and spotting. Control efforts at the fire head likely ineffective. This fire would require indirect attack methods
Very High	>11 feet	Crowning, spotting, and major fire runs are probable; control efforts at the head are likely ineffective. This fire would require indirect attack methods

1.7 ENVIRONMENTAL CONSEQUENCES

Table 5 compares Alternatives 1, 2 and 5. Alternatives 3 and 4 would be the same as alternative 2 for fuels effects and were not broken out in the table.

Table 5 – Fuel Load Comparison By Alternatives

Alternative	Average of all plots taken in Bear Unit								Average of all plots taken in Bear Unit							
	Projections of Surface Fuel Loading in Tons/Acre (10 Year Cycles)								Percent Surface Fuel Load Reduced (10 Year Cycles)							
	2019	2029	2039	2049	2059	2069	2079	2089	2019	2029	2039	2049	2059	2069	2079	2089
#1 - No Action	12	79	132	137	128	122	110	100	0%	0%	0%	0%	0%	0%	0%	0%
#2 - Proposed Action	3	10	15	16	16	15	15	14	27%	88%	88%	88%	88%	88%	87%	86%
#5 - Retain All Snags >21" DBH	3	34	60	66	68	67	64	60	27%	57%	55%	51%	47%	45%	42%	40%
Alternative	Average of all plots taken in LSR Unit								Average of all plots taken in LSR Unit							
	Projections of Surface Fuel Loading in Tons/Acre (10 Year Cycles)								Percent Surface Fuel Load Reduced (10 Year Cycles)							
	2019	2029	2039	2049	2059	2069	2079	2089	2019	2029	2039	2049	2059	2069	2079	2089
#1 - No Action	14	97	165	179	174	164	150	137	0%	0%	0%	0%	0%	0%	0%	0%
#2 - Proposed Action	4	10	15	15	15	15	14	14	27%	90%	91%	91%	91%	91%	91%	90%
#5 - Retain All Snags >21" DBH	4	55	98	109	112	111	106	99	27%	43%	40%	39%	35%	32%	30%	28%
Alternative	Average of all plots take in OPPO Unit								Average of all plots taken in OPPO Unit							
	Projections of Surface Fuel Loading in Tons/Acre (10 Year Cycles)								Percent Surface Fuel Load Reduced (10 Year Cycles)							
	2019	2029	2039	2049	2059	2069	2079	2089	2019	2029	2039	2049	2059	2069	2079	2089
#1 - No Action	12	69	116	124	124	121	117	113	0%	0%	0%	0%	0%	0%	0%	0%
#2 - Proposed Action	3	10	16	16	16	16	15	15	27%	86%	87%	87%	87%	87%	87%	87%
#5 - Retain All Snags >21" DBH	3	50	91	100	102	103	102	100	27%	28%	22%	20%	17%	15%	13%	12%

1.7.1 ALTERNATIVE 1: NO ACTION ALTERNATIVE

Direct Effects:

Under this alternative, no treatments in the proposed area would take place. Observed trends in fuel accumulation and vegetative structure would likely continue causing fuel loading and vegetation densities to increase.

The burned area would continue its natural processes as snags fall and accumulate as surface fuels. Brush and knobcone will continue to grow into areas that burned at higher severity. Snags

currently standing would fall over time, with the majority of small to mid- sized snags falling in the next 10 years followed by larger trees and tree species that decay slower. Fallen snags will continue to accumulate as surface fuel on the ground while shrub regeneration is simultaneously occurring. This will cause excessive fuel loads and an increasing likelihood of future large wildfires due to the increases in the difficulty of fire suppression and high fire severity. The greatest potential concern related to fuels management in this area is the potential for numerous trees to contribute to resource damage and difficulties for fire suppression in future wildfires. These potential impacts are related to a large build-up of logs causing fires to burn more intensely (putting off more heat at any given time) and have higher residence times (burn in one place for a longer time). Higher fire intensities and residence times have greater impacts on surrounding vegetation and the soil near logs. For example, trees (including larger trees) that have these fuel buildups near them are at much higher risk of mortality from cambium layer damage. High accumulations of downed fuels cause an increase in fire intensity. Unfortunately, the consequences of this increase in total energy to wildfire behavior cannot be determined by today's operational fire behavior models, which were designed to predict the forward spread rate of thin linear flame zones. The semiempirical formulation of the fire models considers only the effect of fine fuel (grasses, foliage, shrubs, and downed wood fuels less than 7.5 centimeters in diameter) on the rapid burning, flaming region (Rothermel 1983). The models do not reflect contributions by large woody material or deep forest floor layers to hours-long energy release behind the flame edge or large-scale effects on atmospheric circulations. In fact, a different and dangerous class of fire behaviors emerges at large scales and depends on the combination of high dead surface fuel loads and long burning times extended across a large area. (Stephenens et al, 2018)

Indirect Effects:

Without treatment, standing dead trees will continue to fall and accumulate as surface fuels. Stands would continue to get denser, ladder fuels would increase, and surface fuel loading would further accumulate. In the event of a wildfire, denser understory conditions can result in a greater risk for wildland fire to burn the entire canopy of stands, to have severe and detrimental effects on water quality, species habitats, and pose a serious threat to life and property as well (See Fisheries/Aquatics Report, Hydrology Report). Elevated levels of large (3"+ diameter) material have the potential to increase fire hazard in the area. While it does not change the probability of a fire, in areas of high fuel concentrations, it does greatly increase the difficulty of fire suppression and likely impacts if a fire occurs.

The no-action alternative does not have any direct effect on air quality. This alternative does have the potential for a significant indirect effect if a wildfire were to occur in the project area.

Cumulative Effects:

Several projects had been completed and were being implemented within the project area before the Ranch Fire burned. The Lakeview Hazardous Fuels Reduction Project and the High

Valley Thinning Project were both within the project area boundary. The Bartlett Hazard Tree Removal is also being implemented in the project area.

1.7.2 ALTERNATIVE 2: PROPOSED ACTION

Under this alternative, a combination of prescribed fire, salvage logging, fuels thinning, and planting will be utilized to reduce future surface fuel loads and restore the landscape to one that is more resilient to wildfire in a WUI setting. The following thinning techniques will be used as appropriate on the landscape to meet objectives: hand thinning and mechanical thinning, hand and mechanical piling, and chipping. Burning would include pile burning, jackpot burning, and understory broadcast burning. Spring and Fall burning would allow for meeting LRMP guidelines for varying prescribed fire intensity, seasonal timing of burns, retention of large woody material, and reducing smoke impacts. Having the flexibility to burn during different seasons allows for managers to meet objectives of prescribed burns. Details of treatment by type and acreage can be found in appendix A.

Fuels Prescriptions: See Appendix A.

Silviculture Prescriptions: See Silviculture Report.

Direct Effects:

Fuel load accumulation over time for different alternatives can be seen in Table 5. Alternative 2 has the greatest effect on reducing future fuel loads to manageable levels. Reducing fuel loads reduces fire behavior. Fuel loads in Table 5 for the Proposed Action show fuel loads of 3 to 22 tons per acre levels. Fuel Models TL1 and TL3 can be used to characterize fire behavior of the lower ends of this fuel load range and TL4 and TL5 for the higher range. It's important to note that Fuel Models only predict fire behavior of material 0-3" dbh for spread rate and flame lengths calculations. In the meantime, Brown's recommendation of 5-20 tons per acre of coarse woody debris applies only to material greater than 3" dbh. Both small diameter (0-3") and larger diameter material (>3") affect fire behavior. Smaller material is considered to have the greatest effect on spread rate and flame lengths in fire behavior fuel models, however it is well known through experience in local wildfires and prescribed fires that larger diameter materials also carry fire and hold intense heat for long periods of time. An area with a more humid climate may experience such large materials not igniting unless in very extreme dry conditions. Locally, even during prescribed burning operations, large logs catch on fire and have long heat residence time and high flame length. They do not directly contribute as much to spread rates of fires in the way finer fuels do. However, the heat generated contributes to pre-heating of fuels, heating of the cambium layer of trees, and have a great effect on fire behavior and fire effects. By reducing future surface fuel loads, the Northshore project area will be more resilient to wildfire and more easily managed with prescribed fire after the proposed action is implemented. Further detailed and discussed below are the main treatment types and their direct effects.

Commercial Thinning:

Harvest operations can be expected to add to the amount of surface fuels in the treated stands even with the harvest methods that remove a majority of slash from the unit. These changes have the potential to increase fire behavior within the stand if material is not removed. However, the proposed action calls for removing surface fuels after tree removal. The treatment of surface fuels is expected to counteract any increase in potential fire behavior resulting from a changed stand structure, leading to a net reduction of potential fire intensity within treated stands. During the time between tree removal and surface fuel treatments (generally 1-3 years) there may be an increase in the intensity of potential fires within the stand. This increase would be seen eventually with natural tree fall.

Studies of some areas conclude that fire intensities were greater in stands that were exposed to wildfire before surface fuels were treated (Graham et al, 1999, Finney et al 2003). Other studies have found that intensities in such stands were comparable to that of untreated stands (Murphey et al, 2007). A report from the Angora Fire showed commercial thin units (with follow up pile burning) to be very effective at moving crown fire to surface fire (Murphey et al, 2007). Similarly, a report from the Moonlight Fire showed commercial harvest units to have reduced canopy loss as compared to untreated units (but not as much as thinning/burning) (Dailey et al, 2008). A report on the American River Complex showed that treated areas not prescribed burned did reduce fire behavior but were still intense enough to kill many overstory trees. However, units that were treated with prescribed burning following treatment reduced the effects of fire behavior even further. A report on the effectiveness of treatments affected by the Cone Fire showed that thinning of stands greatly reduced mortality of trees subjected to the fire and stands that were thinned and followed by prescribed fire showed even greater reduction in mortality (Cone Fire 2007). The Cone Fire was also used in a study of snag longevity and surface fuel accumulations post fire in Ponderosa Pine dominated stands and showed that post fire accumulations of surface fuels in unsalvaged units exceeded management ranges recommended by Brown et al (2003) (Ritchie et al, 2012).

Thinning of trees less than and equal to 21" dbh in plantations and naturally forested, previously forested or future planted areas:

Direct effects on fire behavior and fuel condition for these treatments are expected to be similar in many regards to those of commercial thinning. Removal of dead trees that will contribute to excessive future surface fuel loading will improve the landscape's resilience to wildfire as well as other disturbances. In green areas and islands that remain after the fire, removal of small trees and brush from the understory of a stand raises the average canopy base height of the stand and lessens the chance that a fire will scorch or burn the canopy of the stand. And treating within a buffer surrounding these areas will help protect what little vegetation survived the Ranch Fire. In some stands within the project area, the removal of some trees in the stand will increase the amount of light and wind

reaching the ground. In these stands, the treatment of surface fuels within the stand and reduction in the number of small trees in the stand are expected to result in less intense fires (as discussed above under commercial thinning).

Mechanical fuels treatment: Direct effects on fire behavior and fuel conditions are expected to be similar in many regards to those described for thinning operations. Since these treatments are proposed in areas of dense understory vegetation, where thinning by other methods would be difficult, they are expected to significantly reduce the potential for intense fires within these stands. As with other thinning activities, the full effects of the treatments for reducing undesirable risks from wildfire will not be achieved until all treatments are complete, including prescribed burning.

Planting: Planting trees in strategic areas will help create future forested stands that are easier to manage with prescribed fire in WUI areas, fuel breaks and in buffer areas that are protecting some other area of value as identified during the planning process.

Prescribed burning:

This treatment is expected to have several direct effects on treated stands. Burning is expected to reduce the amount of small diameter surface fuel present in treated stands. Burning is expected to kill some portions of understory vegetation within timbered stands and reduce shrub regrowth. This will reduce the potential intensity of wildfires that burn through the area for up to 10-15 years post prescribed burn entry (Keifer et al 2006). The actual amount of surface fuel or understory vegetation consumed by burning is highly dependent on the conditions at the time of burning. Burning is also expected to kill some larger trees within timbered stands. Mortality is expected to vary with stand structure and conditions at the time of burning but is expected to be less than 10% in trees over 16" DBH. Burning is expected to remove some existing snags and logs from the treated stands. It will also create new snags and logs through overstory mortality (Stephens and Moghaddas, 2005) (Bagne and Others 2008). While some large woody debris is likely to be consumed, at least the minimum of required levels per Best Management Practices will be maintained. In areas where green trees were left, burning is also expected to raise the average canopy base height of treated stands as these stands regrow. Chaparral burning would have several direct effects including: 1) reducing wildland fire hazards and 2) moving towards returning diversity in brush seral stages. Diversity in seral stages is beneficial to the wildlife that are dependent on the brush for habitat and food sources. While prescribed burning can be used as a tool to thin small diameter (generally less than 6" dbh) trees, it takes several entries of fire to successfully thin such a stand. The initial burn would kill some of the small diameter trees but those would be left standing dead, which acts as dead ladder fuels. At least one additional entry of prescribed fire is needed to consume these fuels. Prescribed burning without hand or mechanical thinning first (especially in multi-story, dense areas) is more likely to carry fire into the canopies of the mid-sized and larger trees that are overstory, resulting in higher risk of mortality to the overstory trees than mechanical or hand thinning of these trees.

Due to the expected increase in fuel loadings over years to come, prescribed burning may require multiple entries in order to meet and maintain objectives.

Prescribed burning is often effective in reducing surface fuel loadings to desirable levels as well as to reducing future shrub regrowth in currently, previously or future forested stands. Shrub regrowth in the timbered stands is expected, even desired to a certain extent as habitat and would not pose high risks of fire activity if kept as a minimal component of these stands. There will be many acres of shrub in the project area that would be managed by prescribed burning only. The amount of shrub and forb regrowth that may be expected would pose less of a fire risk than the no-action alternative and would allow natural ignitions to burn through the stand with less torching/crowning and mortality than under the no-action alternative. Even with higher fire return intervals under historical fire regimes, it would have been natural to have some patches of brush and forb growing in timbered stands.

Indirect Effects:

For all units, treatments are expected to have a beneficial effect on immediately adjacent, un-treated stands for a short distance. In case studies of the effectiveness of fuel treatments exposed to wildfires, treated units modified the behavior of fires for up to 300' beyond the unit (Murphy et al, 2007). Treatments would decrease fuel loading, continuity, and promote a more fire resilient landscape. Fires are expected to move more slowly and with less intensity through treated units. Studies have shown that treatment units strategically placed within a landscape can slow the growth of large fires (Finney 2001, Finney 2006). While fires are a natural and necessary part of the ecology of this area, post-fire conditions create the potential for reburn fires of greater intensity and size than are normal for the area (as outlined previously in this report) and the ability to suppress or mitigate such fires will be an important part of restoring this area to more ecologically resilient conditions.

Treatments, as proposed, are expected to have the indirect effect of lowering the potential emissions of a summer wildfire (after implementation of treatments) in the project area. This indirect effect is the result of removing some of the fuel in the project area and of making some of the fuel remaining in the stand unavailable to burn. Fuel is removed by removing commercial timber, pre-commercial and understory trees less than 10 inches DBH, and by burning some of the surface fuel in a prescribed fire. Some of the remaining fuel is made unavailable to burn by reducing the chance of tree crowns burning under all but the most extreme conditions.

Cumulative Effects:

Several projects have been completed were being implemented within the project area before the Ranch Fire burned. The Lakeview Hazardous Fuels Reduction Project and the High Valley Thinning Project were both within the project area boundary. The Bartlett Hazard Tree removal is also being implemented in the project area.

Treated units in this project that burned at lower severity levels in the Ranch Fire are expected to have an effect on the growth of large fires in the project area that is cumulative with

previous and on-going treatment units within as well as adjacent to the project area (projects are listed above). All of these projects combined can be expected to have a cumulative reduction on the potential size of fires that are large enough to contact more than one treatment (Finney 2001).

Because of the widespread, but short-lived, impacts of emissions from fire, no other projects were considered for this cumulative smoke/emissions impact analysis. Emitted pollutants from fire do have an effect on an area, the size of which depends on atmospheric conditions at the time of the fire. Within this area, pollutants from fires can be cumulative with emissions from many sources, including other fires, vehicles, industrial sources, buildings and agriculture. It is impossible to predict what pollution sources may be present at the time of a fire occurring at some unspecified date in the future.

Road brushing – This activity is routinely carried out by fire crews as part of road maintenance. This is not expected to cause cumulative effects within the project since it is carried out within 5 feet of roadsides and only affects brush and small trees growing within that distance.

1.7.3 ALTERNATIVE 3:

Direct Effects:

This alternative would follow actions proposed in Alternative 2 but does not include any use of herbicides except in research plots. There is no change in hazardous fuels effects between alternative 2 and 3 because it is assumed that this work would still be accomplished utilizing other tools.

Indirect Effects:

As described under the Indirect Effects section for Alternative 2, treatments are expected to have a beneficial effect on immediately adjacent, un-treated stands for a short distance.

Cumulative Effects:

Cumulative effects would remain the same as in Alternative 2.

1.7.4 ALTERNATIVE 4:

Direct Effects:

This alternative would follow actions proposed in Alternative 2 but does not include any use of herbicides. There is no change in hazardous fuels effects between alternative 2 and 4 because it is assumed that this work would still be accomplished utilizing other tools.

Indirect Effects:

As described under the Indirect Effects section for Alternative 2, treatments are expected to have a beneficial effect on immediately adjacent, un-treated stands for a short distance.

Cumulative Effects:

Cumulative effects would remain the same as in Alternative 2.

1.7.5 ALTERNATIVE 5:**Direct Effects:**

This alternative would follow actions proposed in Alternative 2 except it would retain all standing snags and LWD greater than 21" DBH. As seen in Table 5, fuel loading in this alternative is lower than the no action alternative but still excessively higher than the 5-20tpa. This excessive fuel load will make future fire suppression difficult, be a threat to values at risk (i.e. WUI, private property, green islands) and the landscape will not be as fire resilient as it would under Alternative 2.

Indirect Effects:

Since treatments have an effect on adjacent untreated stands for a short distance (see indirect effect in Alternative 2), there may be a loss of benefit to these stands based on expected fire behavior under this treatment.

As this alternative would not remove as many trees/fuels from these units, there will be more fuel left available to burn during a wildfire. This may cause the potential for a higher level of emission being created during a wildfire.

Cumulative Effects:

Cumulative effects would remain the same as in Alternative 2 except that there would be less of a cumulative reduction in potential wildfire size as compared to Alternative 2.

1.8 SUMMARY OF EFFECTS

Alternative 2, 3 and 4 would have a substantial reduction in fuel load levels and thus a great reduction in flame lengths greater than 4 feet when compared with the no action alternative. Alternative 5 would have some reduction but not as much as Alternatives 2, 3 and 4. Alternative

2 would have the most benefit in creating a post fire landscape that is manageable considering future wildfires in WUI and climate change. It would have the most reduction in loss of future habitat in the event of a wildfire. The ability of firefighters to safely and effectively suppress wildland fire would also be improved by implementing Alternative 2. The selection of this alternative would contribute to the purpose and need, the desired condition, forest plan direction, and respond to the National Fire Plan goals of reducing hazardous fuels to modify fire behavior.

1.9 COMPLIANCE WITH LAW, POLICY, REGULATION, AND FOREST PLAN

MENDOCINO NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN DIRECTION

Land management activities on the Upper Lake Ranger District are directed by the Mendocino National Forest (MNF) LRMP (USDA 1995) specifies forest-wide standards and guidelines, as well as area-specific guidelines. Regarding fuel treatment and fire hazards, it directs (Section IV- Management Direction: Fire and Fuels, pg. 21):

8. Treat fuels to reduce the potential rate of spread and fire intensity so the planned initial attack organization can meet initial attack objectives.

The proposed actions comply with this direction by reducing fuel loading below what is considered to be the upper limit of what can be addressed using direct attack suppression tactics

10. Emphasize fuels treatment efforts for fire hazard reduction purposes in the following areas:

Natural Fuels (d): forested areas with excessive accumulations of natural fuels.

Activity Fuels (b): where treatment is necessary before initiating other multi-resource management projects, e.g., reforestation.

Manage National Forest activities to maintain air quality at a level which meets or exceeds State and/or local government regulations.

All prescribed burning is coordinated with and approved by Lake County Air Quality Management District to ensure that state and local air quality objectives are met.

Provide for protection from wildfire, through timely detection and suppression response with appropriate forces, such that cost plus net resource loss due to wildfire is minimized. All wildfires will be contained, confined, or controlled in accordance with specific management area direction.

Proposed action would create treatments that after completion, are expected to reduce cost of wildland fire responses as well as reduce resource loss due to potential wildfires. After project completion, the project area will be in conditions that will allow for a more efficient and safer suppression response.

Emphasize fuels treatment efforts for fire hazard reduction purposes in the following areas:

- ***Natural Fuels: Continuous, mature brush stands of more than 150 acres adjacent to or within areas of urban interface, resource investments, or high fire hazards;***
 - ***Continuous, mature brush stands more than 25 years old;***
 - ***Continuous, mature brush stands with dead-to-live ratios greater than 35%***
 - ***Forested areas with excessive accumulations of natural fuels***
- Activity Fuels:***
- ***In zones of urban interface or other high hazard areas;***

- ***Where treatment is necessary before initiating other multi-resource management projects, e.g. reforestation***

Brush burning is proposed primarily in large continuous, mature brush fields. The project would treat excessive accumulations of natural fuels.

Design fuel treatment and fire suppression strategies, practices, and activities to meet Aquatic Conservation Strategy objectives, and to minimize disturbance of riparian ground cover and vegetation...

No machine piling would occur in riparian reserves; Hand Piles (if created) would be located a minimum of 25 feet from the high water mark, unless on a topographic break (flat or bench with slope <20%). The small sizes and scattered arrangement of hand piles minimize disturbance to ground cover and vegetation.

Integrate multi-resource management objectives into fire hazard reduction efforts. Design prescribed fire projects and prescriptions to contribute to attainment of Aquatic Conservation Strategy objectives.

The fuels reduction treatments in the Proposed Action will assist in long-term maintenance and protection of the Riparian Reserves and will attain ACS objectives. Potential short term impacts are minimal due to design features and BMPs.

Consider the particular needs for the specific vegetative communities and sensitive plants where prescribed burning is used as a vegetation management tool (e.g. within the 'shrub hardwood' type). Vary or adjust the frequency, intensity, and timing of prescribed burning proposals as necessary to protect specific vegetation types, botanical diversity, and the viability of sensitive plant species.

The proposed action would use fire as a vegetation management tool for shrub and hardwoods. Having the use of Spring and Fall burning (as proposed) would allow for varying intensity and timing of prescribed burns that would help meet project goals. The purpose and need describes the existing and desired conditions of these vegetative communities.

References Cited

Agee, J. K. 1993. Fire ecology of Pacific Northwest forests. Island Press, Covelo, California, USA.

Agee, J.K., Skinner, C.N. 2005. Basic principles of forest fuel reduction treatments. *Forest Ecology and Management* 211(2005) 83-96.

Bagne, K., Purcell, K., Rotenberry, J. 2008. Prescribed fire, snag population dynamics, and avian nest site selection. *Forest Ecology and Management* 255(2008) 99-105.

Beaty, R.M., Taylor, A.H. 2001. Spatial and temporal variation of fire regimes in a mixed conifer forest landscape, Southern Cascades, California, USA. *Journal of Biogeography* 28: 955-966.

Bigelow, Seth W., North, Malcolm P. 2011. Microclimate effects of fuels-reduction and group-selection silviculture: Implications for fire behavior in Sierran mixed-conifer forests. *Forest Ecology and Management* 264(2012) 51-59.

Bigler, C., Kulakowski, D., Veblen, T. 2005. Multiple disturbance interactions and drought influence fire severity in Rocky Mountain subalpine forests. *Ecology* 86 (11): 3018-3029.

Brown JK, Reinhardt ED, Kramer KA (2003) Coarse woody debris: managing benefits and fire hazard in the recovering forest. USDA Forest Service, Rocky Mountain Research Station, General Technical Report GTR-RMRS-105. (Ogden, UT)

Calkin, D., Gebert, K., Jones J., Neilson, R. 2005. Forest Service Large Fire Area Burned and Suppression Expenditure Trends, 1970-2002. *Journal of Forestry*. 103 (4): 179-183.

Cone Fire Report. Tested By Fire. 2007. Published by Pacific Southwest Research Station, USDA Forest Service James R. Sedell, Station Director, 800 Buchanan Street, Albany, CA 94710

Dailey, Scott., Fites, JoAnn., Reiner, Alicia., Mori, Sylvia. 2008. Fire Behavior and Effects in Fuel Treatments and Protected Habitat on the Moonlight Fire. Prepared by The Fire Behavior Assessment Team, USDA Forest Service, Pacific Southwest Research Station.

Finney, M. 2001. Design of regular landscape fuel treatment patterns for modifying fire growth and behavior. *For. Sci.* 47(2):219-228.

Finney, M., Bartlette, R., Bradshaw, L., Close, K., Collins, B., Geason, P., Hao, W.M., Langowski, P., McGinely, J., McHugh, C., Martinson, E., Omi P., Shepperd, W., Zeller, K. 2003. Fire behavior, fuel treatments, and fire suppression on the Hayman Fire. In: Graham, R. Tech. Ed. Hayman Fire Case Study. 2003. Gen Tech Rep. RMRS-GTR-114. Ogden, UT. USDA Forest Service, Rocky Mountain Research Station. 33-180.

Finney, M. 2006. A Computational Method for Optimizing Fuel Treatment Locations. In: Andrews, Patricia L.; Butler, Bret W., comps. 2006. Fuels Management—How to Measure Success: Conference Proceedings. 28-30 March 2006; Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Finney, M. 2006 (b). An Overview of FlamMap Fire Modeling Capabilities. In: Andrews, P., Butler, B., comps. 2006. Fuels management – How to Measure Success: Conference Proceedings. March 28-30, 2006. Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO. USDA Forest Service, Rocky Mountain Research Station.

Graham, R., Harvey, A., Jain, T. Tonn, J. 1999. The effects of thinning and similar stand treatments on fire behavior in Western forests. Gen Tech. Rep. PNW-GTR-463. Portland, OR. USDA Forest Service, Pacific Northwest Research Station. 27p.

Hann, W.; Shlisky, A.; Havlina, D.; Schon, K.; Barrett, S.; DeMeo, T.; Pohl, K.; Menakis, J.; Hamilton, D.; Jones, J.; Levesque, M.; Frame, C. 2004. Interagency Fire Regime Condition Class Guidebook. Last update January 2008: Version 1.3.0 [Homepage of the Interagency and The Nature Conservancy fire regime condition class website, USDA Forest Service, US Department of the Interior, The Nature Conservancy, and Systems for Environmental Management]. [Online]. Available: www.frcc.gov.

Johnson, MC, Kennedy MC. 2020. Effects of post-fire management on dead woody fuel dynamics and stand structure in a severely burned mixed-conifer forest, in eastern Washington State, USA.

Keifer, M. B., J. W. van Wagtenonk, and M. Buhler. 2006. Long-term surface fuel accumulation in burned and unburned mixed-conifer forests of the central and southern Sierra Nevada, CA (USA). *Fire Ecology* 2: 53-72.

Landfire: LANDFIRE National Vegetation and Disturbance Dynamics Models. (2008 - last update). [Homepage of the LANDFIRE Project, U.S. Department of Agriculture, Forest Service; U.S. Department of Interior],[Online].Available: <http://www.landfire.gov/index.php> [2008, December 10].

LANDFIRE: Landfire Fire Regime, Mean Fire Return Interval Data Product. Available: <http://www.landfire.gov/fireregime.php>

Lynch, H., Renkin, R., Crabtree, R., Moorcroft, P. 2006. The influence of previous Mountain Pine Beetle (*Dendroctonus ponderosae*) activity on the 1988 Yellowstone fires. *Ecosystems* 9: 1318-1327.

Mendocino National Forest Fire Management Plan, 2011, 28-29

Mendocino National Forest Land and resource Management Plan, 1995, IV 21

Murphy, K., Rich, T., Sexton, T. 2007. An Assessment of Fuel Treatment Effects on Fire Behavior Suppression Effectiveness and Structure Ignition on the Angora Fire. USDA R5-TP-025. 32p.

Nemens, DG, Varner, JM, Johnson, MC. 2019. Environmental effects of postfire logging: an updated literature review and annotated bibliography. Gen. Tech. Rep. PNW-GTR-975. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 35 p.

NWCG Fireline Handbook, 2004 A-30Olsen, W.K., Schmid, J.M., Mata, S.A. 1996. Stand characteristics associated with Mountain Pine Beetle infestations in Ponderosa Pine. *Forest Science* 42(3): 310-327.

The National Map LANDFIRE: LANDFIRE National Mean Fire Return Interval layer.
(2008, last update). U.S. Department of Interior, Geological Survey. [Online]. Available:
<http://gisdata.usgs.net/website/landfire/> [2008, Dec 3].

Ritchie, M., Knapp, E., Skinner, C. 2012. Snag longevity and surface fuel accumulation following post-fire logging in a ponderosa pine dominated forest. *Forest Ecology and Management* 287. USDA Forest Service, Pacific Southwest Research Station

Rothermel, R. C. 1972. A mathematical model for predicting fire spread in wildland fuels. Res. Pap. RPINT-115. Ogden, UT. USDA Forest Service, Intermountain Forest and Range Experiment Station. 40p.

Safford, Hugh. Fire Severity in Fuel Treatments American River Complex fire, Tahoe National Forest, California June 21-Aug1 2008. USDA Forest Service, Pacific Southwest Region, Vallejo CA 95492.

Sikkink, P., Keane, R. 2008. A comparison of five sampling techniques to estimate surface fuel loading in montane forests. Collingwood, Victoria, AU. *International Journal of Wildland Fire* 17:363-379.

Skinner, C., Abbott, C., Fry, D., Stephens, S., Taylor, A., Trouet, V. 2009. Human and climatic influences on fire occurrence in California's North Coast range, USA. *Fire Ecology* v. 5, no. 3. 76-99.

Stephens, S., Fry, D. Fire History of Two Mixed Conifer Forest Sites in the Mendocino National Forest, Northern Coast Range, California. 2008. Unpublished report. Berkeley, CA: University of California, Berkeley, Dept of Environmental Science, Policy and Management. 16

Stephens, S., Moghaddas, J. 2005. Fuel treatment effects on snags and coarse woody debris in a Sierra Nevada mixed conifer forest. *Forest Ecology and Management* 214 (2005) 53-64.

Stuart, J., Salazar, L. 2000. Fire History of White Fir Forests in the Coastal Mountains of Northwestern California. *Northwest Science*. 74 (4): 280-285.

Taylor, A., Skinner, C. 1998. Fire history and landscape dynamics in a late-successional reserve in the Klamath Mountains, California, USA. *Forest Ecology and Management* 111:285-301.

Taylor, A., Skinner, C. 2003. Spatial patterns and controls on historical fire regimes and forest structure in the Klamath Mountains. *Ecological Applications* 13: 704-719.

Watershed Analysis Report for the Upper Main Eel Watershed. United States Forest Service and Bureau of Land Management. 1995

Wells, G. 2008. The Rothermel fire-spread model: Still running like a champ. Rohling, K. ed. *Fire Science Digest* : 2. March, 2008. Boise, ID. National Interagency Fire Center, Joint Fire Science Program.

Wills R., Stuart, J. 1994 Fire History and Stand Replacement of a Douglas Fir/ Hardwood Forest in Northern California, *Northwest Science* 68(3): 205-212

APPENDIX A – MAPS

APPENDIX B – Fuels Prescriptions

F1 - Prescribed Burning: prescribed burning is proposed across all vegetation types within the Northshore Project area. Prescribed burning includes vegetation treatments such as: pile burning, jackpot burning, understory burning, and broadcast burning. Treatment activities require control lines to be established to aid in holding efforts. Control lines where possible, utilize existing natural or preexisting features such as ridge tops or roads or trails. Control lines are created with the minimum necessary width to hold the prescribed burn within a given boundary, and provide flexibility in controlling how much area is burned at any one time. They are also utilized to curtail activities should conditions become unfavorable.

Control lines are typically hand lines accompanied by a wider area cleared of vegetative material with a chainsaw. Hand lines usually require a 2-3 feet wide scrape down to mineral soil accompanied by a 4-8 feet cutting of vegetation to augment the hand scrape. Mechanical control lines would be limited to a width of ten feet. Mechanical treatment is confined to slopes 35 percent or less. Limited to areas where archeological surveys have been completed and cleared for mechanical work. Mechanical control lines erosion control measure for stabilization will follow hydrological guidelines as set forth in the project's Hydrology Report.

F2 - Fuels thinning outside the Ranch fire burn scar: thinning of trees and shrubs <12" DBH* Tree's shall be thinned to a 15-25 feet spacing. All shrubs shall be removed unless needed to meet spacing requirements in which case manzanita will be the first choice for shrub retention. An individual shrub or clump of shrubs may be left where trees as sparse and not enough exist to keep from having opening greater than 25 feet. Where no trees or manzanita exist (for example Chamise Redshank Chaparral vegetation type), clumps of chaparral 5-10 feet in diameter shall be retained on a 25-50 feet spacing in areas being thinned. Thinning will be prioritized in the identified high value areas and within buffer zones. Some areas of chaparral will be prescribe burned only to provide for a mosaic of chaparral age class diversity for wildlife.(LRMP) Mechanical treatment may be applied on slopes <35% and slopes >35% shall be hand treatment only.

F3 - Fuels thinning within the Ranch fire burn scar: thinning of trees and shrubs less than 21" DBH is proposed across the Northshore Project area. Fire killed trees would be felled and material may be piled, chipped, masticated, lopped, or removed off site. Felling operations would be done mechanically or by hand. (Slopes less than 35% would be treated mechanically and/or by hand; slopes greater than 35% shall be treated by hand methods only). Trees less than 21" DBH exhibiting less than 0.7 probability

of mortality as determined by the Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011) shall be left at a 15-30 foot spacing. Trees that have more than a 0.7 probability of mortality will be felled unless retention is necessary for wildlife snag requirements.

Large diameter thinned trees may be left on the ground as coarse woody debris unless fuel loading is excessive. The minimum coarse woody debris requirements shall still be met.

Mechanical thinning will be limited to slopes that are 35% or less. Mechanical thinning would be used to chip, masticate, mulch or pile vegetation which would then be either removed as biomass or if that is not possible, burned on site or off-site (i.e. in curtain burners).

Hand-thinning will have no slope restrictions. Hand thinned material would either be chipped or piled for removal (to biomass facilities, burn curtains, decks, etc.) or burned.

Hardwood tree release and enhancement (primarily Oak species): thin oaks to 1-3 stems to encourage oak trees to develop in the shape of a tree rather than an oak in the shape and form of a shrub. Prune trees as needed

F4 - Fuels thinning of non-commercial trees >21" dbh: Trees 21" and above exhibiting any sign of green shall be retained on a 15-30 foot spacing from trees less than 21" DBH; therefore, not following the marking guidelines for fire killed trees.

F5 – Fuelbreaks:

500 feet Shaded fuel breaks: Fuels breaks would be 500' in width following ridgelines and road systems. Remove all dead trees. Retain live trees at 25-35' spacing. Where live trees do not exist, consider planting to create a "shaded fuel break". Mechanical or hand thinning would be used depending on slope. Prescribed burning shall also be utilized. See treatment F1.

Pre-existing strategic fire breaks. The same fire breaks have been created and re-utilized many times due to their strategic locations during wildfire suppression actions. Because of their strategic use, the same fire breaks would very likely be used in the future. Maintaining these fire breaks would increase the likelihood of success of these firebreaks. Firebreaks are generally previous dozer lines. These fire breaks would be maintained by keeping them clear of vegetation along the dozerlines. Thinning treatment would be applied to a 500width (generally 250' on each side or adjusted as topography or vegetation dictates) from the center of the dozer line. Thinning shall be on the 25-35 feet spacing encouraging the shaded fuel break concept from above where feasible.

Where no trees exist, shrubs may be kept in clumps no greater than 10 feet in diameter and at a 35' spacing to break up fuel continuity.

(Knobcone shall not be left as a leave tree in any circumstances on fuel breaks and fire breaks. Consider planting native grasses and/or forbs to be manage through prescribed burning. This would be used primarily if a continuous low fire hazard fuel bed is desired to be able to use prescribed fire to keep shrubs from taking over fuel breaks)

F6 - Knobcone management: Focus knobcone management in areas that are accessible such as:
Fuel breaks,

Along roadsides (particularly those that provide ingress/egress for the public as well as employees and fire personnel),
WUI management areas,
High value protection areas,
Buffer zones where a feathered treatment will be applied, and
Where knobcone needs to be managed to reduce fire intensity entering these areas.

Knobcone prescription: Base on location to high value area. Mechanical thinning and prescribed burning multiple times over a short period of time.

Because little research exists on knobcone management, adaptive management process will be critical in this project. Potentially a second or third rotation of a thin/burn/thin may curtail knobcone expansion into other vegetation types. Perhaps there is a potential to develop stands with reduced density of knobcone and higher density of other tree species. While the intent is to manage this species aggressively in key areas high Value areas, we recognize that knobcone also has a role in the natural ecosystem. There are thousands of acres of closed cone cypress vegetation type that will be managed through following the minimal management treatments such as limited to prescribe burning on a more historical fire regime only.

Multiple entries of thinning and burning treatment would likely be necessary in close intervals to discourage cone production and limit fire induced seed germination. To promote root burl survival of hardwood species prescribed fire will be applied at cooler temperatures.

To help develop a stand that is not dominated by knobcone where soil conditions are favorable plant trees that would eventually shade out knobcone trees.

To discourage knobcone from expanding into shrubland habitat develop and maintain a shrubland prescribed fire program. Refer to Fire and Fuels Report.

Thinning of future green stands (both plantation and naturally regenerating) shall follow the “Standards for Precommercial Thinning” prescription in the Silviculture Prescriptions in Section 7.8 of the silviculture Report. It is important from a fuels standard to reduce flammable vegetation such as shrubs growing up around desired leave trees and to reduce ladder and surface fuels.

The focus of thinning will be primarily in the focus value areas that were identified by an ID team comprising of District and SO staff, ecologists and Firescape members, community input, and through the Scoping process. Areas adjacent to these focus areas that need fuels treatments to protect them from future undesired wildlife effects would also utilize the appropriate thinning prescriptions. The focus areas were identified as:

- areas being commercially thinned, and/or re-forested (or other high investment areas),
- wildlife habitat enhancement areas such as protection of legacy trees (dead or alive) and 100 acre LSR's or activity centers,
- legacy green islands,
- WUI areas and fuel breaks,
- areas adjacent or near private boundaries,
- areas where natural regeneration of tree species are occurring and thinning or release of these trees will help promote stand development, and
- Buffer Zones

Buffer zones are areas surrounding high value areas where treatment is designed to protect the focus areas but due to cost and resource availability may be treated less intensely, or with varying intensity (Feathered treatment) as the treatments move away from the focus area.

- Feathering Treatments

Feathered treatment buffers around focus areas and help the transition of fire behavior before the fire front enters these areas. Buffered areas will be treated to gradually reduce fire intensity as the fire front enters the focus areas. A feathered treatment is a strategy that treats focal areas and the area immediately surrounding it most intensely and gradually less intensely as the treatment moves away from the focus area. For example a wider tree spacing may be used within the focus area and immediately adjacent to the focus area followed by continued effort to go back in and thin shrubs until the trees are large enough to shade out shrubs and small trees growing in as ladder fuels. But the next layer would be thinned less intensely and less periodically. And the next layer may either be thinned once or even only prescribe burned. Conducting fuels treatment effectiveness monitoring post wildfire has shown that this intense treatment of focal areas with feathered treatments surrounding to have the most successful outcomes when tested by wildfire.

Feathered treatments may also be applied to individual habitat elements such as live legacy trees, or snags to protect it from future undesired fire effects.

- Mendocino National Forest post fire treatment effectiveness monitoring has demonstrated that treatment buffers around high value areas where a feathered thinning treatment (graded density reduction) helps modify fire behavior before the fire front enters these areas.
- Clearing around individual high value live or dead trees (i.e. wildlife tree or snag) to protect it from future fire effects.

- Thinning treatments may be needed near private boundaries for various reasons including potential cross-boundary treatments to protect lands being treated from lands not being treated for fuels reduction.
- Prescribed Burning: Using prescribed burning for ecosystem benefits and forest management is the ultimate goal. However, getting to that point will require many different stages and applications of prescribed burning along with other methods of fuel load management. For example some areas cannot successfully be prescribed burned without undesired effects to soil, habitat or without other resource concerns while other areas may utilize post fire conditions and start using prescribed fire to maintain and improve conditions that the recent fires have created. In the Northshore Restoration Project, prescribed burning will be utilized in the following ways 1) where conditions allow, to use the 2018 burn as a baseline and burning on appropriate intervals to keep ecosystem healthy and functioning, 2) as an interim treatment (ie pile burning following piling operations will be implemented to reduce fuel loading and broadcast burning will be implemented following mastication or chipping type of treatments that rearrange fuels but still need burning to reduce fuel loads) and 3) as a repeat and/or maintenance burning on appropriate intervals to reach desired goals.

APPENDIX C - Terminology

Canopy Fires – Fires that burn most of the live canopy of the vegetation (trees or brush)

Crown fires - The movement of fire through the crowns of trees or shrubs

Flame Lengths - the distance measured from the average flame tip to the middle of the flaming zone at the base of the fire

Fuels - Combustible material. Includes, vegetation, such as grass, leaves, ground litter, plants, shrubs and trees that feed a fire.

Ladder Fuels - live or dead vegetation that allows a fire to climb up from the forest floor into the tree canopy

Surface Fires – fires which spread with a flaming front and burn leaf litter, fallen branches and other fuels located at ground level

Surface Fuels - Fuel lying on or near the surface of the ground and consisting of leaf and needle litter, live and dead branch material, downed logs, bark, tree cones, and herbaceous material of low stature

Torching: The ignition and flare-up of a tree or small group of trees, usually from bottom to top

